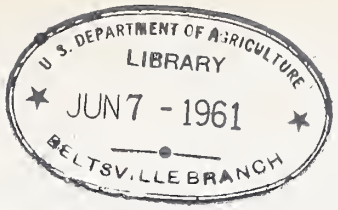

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LONG FIBER BURNISHING, RIBBONING, AND CLEANING MACHINE

By

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INTRODUCTION

In 1943, a cooperative agreement between the University of Florida Agricultural Experiment Station and the United States Department of Agriculture initiated a program of research in the growing and processing of long vegetable fibers.

In the early phases of the work, engineering research was devoted to the development of methods and machines for the extraction and preparation of hard fiber from leaf type plants for cordage uses and of soft fiber from stem type plants for twines, hessians, textiles, and a variety of other products. On-the-farm treatment was to be carried to the point where the fiber was in the best possible condition and, when feasible, ready for the spinner. All processes were to be fully mechanized by the use of several machines when necessary.

The simple inexpensive machine described in this publication was originally designed to upgrade leaf or cordage fibers after decortication and drying. Later it was found to have a number of worthwhile applications on stem fibers, particularly ramie and kenaf. The construction of this machine and some of its applications will be discussed in this publication.

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DESCRIPTION OF THE MACHINE

This machine was designed to be extremely simple (figs. 1-3). It requires no precision parts or close tolerances, the drum and feed roll being the only movable parts. It can be constructed in any small machine shop from steel shapes readily available.

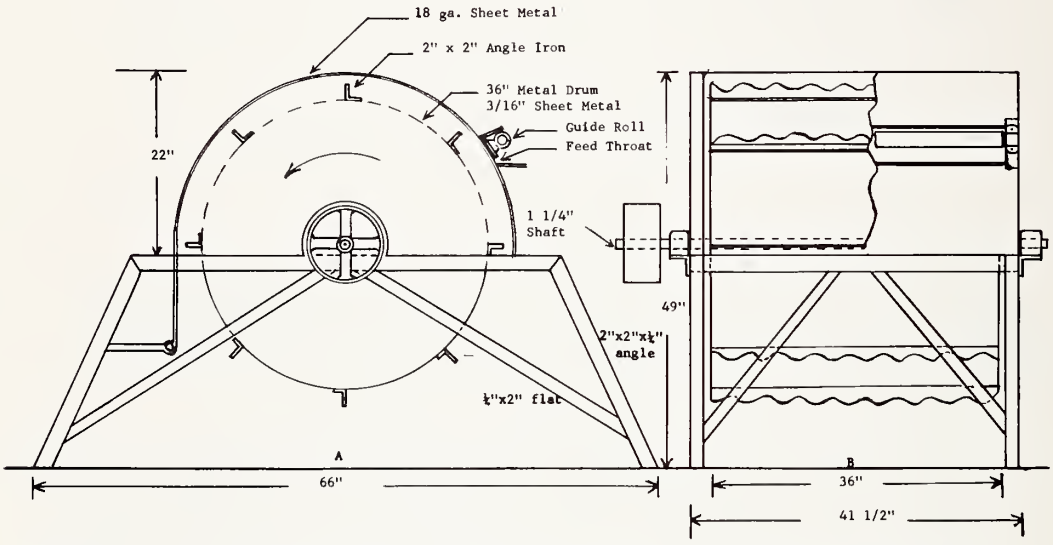

Figure 1. A lightweight fiber processing machine developed in the Agricultural Engineering Laboratories.

a. Cross section view
b. Partially sectionalized front view

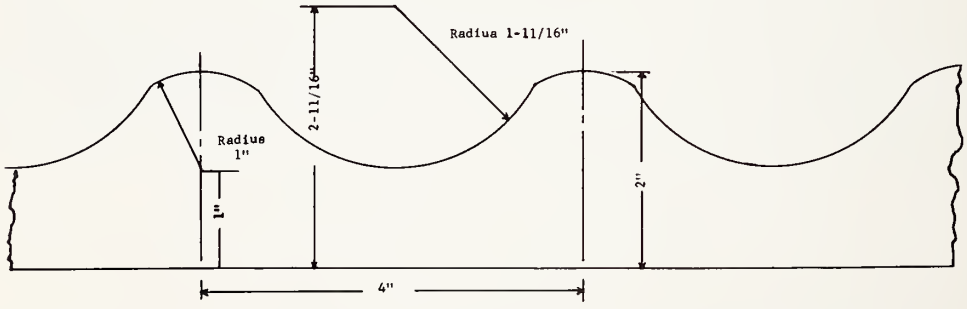

Figure 2. Section of bars for drums rough cut from 2" x 2" x 1/4" angle ground smooth.

Figure 3. The burnishing-ribboning machine operating as a burnisher on sansevieria fiber that has just been decorticated and dried. This operation cleans, alines, and improves the color and sheen of the fiber. This machine is also used to ribbon ramie and kenaf; to clean and wash retted fiber.

The experimental model constructed in the laboratory consisted of a drum rolled from 10-gage black sheet iron (3/16-inch plate is recommended), mounted on a 1 1/4-inch shaft and positioned in bearings supported by an angle-iron frame braced by strap iron.

Eight serrated blades are mounted on the face of the drum, the serrations being offset on alternate blades to give a combing action to the fiber. Blade construction and arrangement are shown in figures 1 and 2.

The top half of the drum is covered by an 18-gage sheet-metal hood positioned 1/2- to 1-inch above the tips of the blades. This clearance is not critical. A slot 6 inches wide extending across the face of the drum positioned about 30 degrees above the horizontal serves as a feed opening. A roll constructed from 2-inch pipe is positioned just above the slot. This aids in presenting material to the drum and also prevents a hand getting caught by the rotating blades.

In operation, the drum rotates upward from the feed slot. Speed of the drum should vary according to the type of fiber and the job to be performed. Speeds of 100 to 350 or 400 r.p.m. have given good results on all types of fiber and do not give excessive vibration even though the drum is not precision constructed or balanced. Hanks of fiber approximately one-half pound in weight are caught by the butt end and the tip fed into the drum where the alternating points on the blades impart a combing, cleaning, alining action, beating and fluffing the fiber against the cover over the drum. After a few seconds, the hank is withdrawn and the process repeated for the butts. The action of the machine on specific fibers will be described later.

CONSTRUCTION OF THE MACHINE

The materials required for constructing the various parts of the machine and a brief description of the procedures in fabricating them are presented below. The construction may be varied to suit individual needs and conveniences; therefore the specifications as given are only suggestions for guidance.

Drum

Materials Required:

1 - Plate 3/16" thick x 36" wide x 114" long for body of drum
1 - Plate 1/4" thick x 36" wide x 72" long for ends of drum (2 - 36" circles)
2 - Steel collars 1-1/4" bore to fit shaft to drum ends
1 - 1-1/4" cold-rolled round shaft 5' long
8 - 1/4" x 2" x 2" x 35" angle irons for blades
2 - 1-1/4" pillow block type precision-ground radial ball bearings. If preferred, babbitt bearings may be used.

Fabrication:

1. Roll 3/16" plate into a cylinder 36" in diameter and weld the edges. Care should be used in rolling the ends to avoid flat places in the periphery.

2. Lay out eight equal divisions on the periphery of the drum for the knives, and if they are to be bolted, drill 3 holes for each knife and weld 3/8" nuts underneath. Knives may be welded to the drum if preferred.

Fabrication (continued)

3. Lay out accurately two 36" circular ends on 1/4" plate and cut with circular attachment on an oxyacetylene cutting torch. Bore center hole to fit collars and weld them to the plate.

4. Fit ends into cylinder to a depth of 1/2" evenly all around and weld in place.

5. If the above construction is accurately done the 1-1/4" shaft should slip through the holes in the collars. Extend shaft through the drum 16" on one end. The shaft may be welded to the collars or secured by keys and setscrews. Slip bearing on the ends of shaft.

6. On four pieces of 1/4" x 2" x 2" x 36" angle irons, lay out scallops as shown in figure 2. Cut these out with the torch and grind and file the edges smooth and slightly convex. Leave no sharp edges.

The other four blades are to be laid out the same way except that the scallops are 90° out of phase as shown in figure 1b. Mount the blades on the drum alternately so that a high point on one matches a low point on an adjacent one.

Drum Cover

Materials Required:

2 - pieces 1/4" x 2" x 48" flat iron for cover supports
1 - piece 18-gage black sheet iron 42" x 66" - top cover
1 - piece 18-gage black sheet iron 43-1/2" x 27" lower cover
1 - piece 1/8" x 2" x 2" x 42" angle iron (top part of feed slot)
1 - piece 2" x 42" black iron pipe with 1" shaft, 6" long fitted in each end to form feed roller
2 - pieces 1" pillow-block, precision-ground ball bearings
2 - pieces 20-gage black iron 22" x 42" for end covers

Fabrication:

1. Curve the strap-iron pieces to 21" radius leaving 1" on each end straight.
2. Weld one to each end of the frame so that the loop is concentric with the drum and about 1/2" above the tips of the blades.
3. Bolt or weld the 1/8" x 2" x 2" angle iron across the two loops 15" above the frame.
4. Spot-weld one end of the top cover plate to the above angle and form it around the 1/4" x 2" loops, using 1/4" round-head stove bolts spaced 8" apart. The plate should extend 12" below the top of the frame to deflect trash coming from the drum.
5. The 1" pillow-block bearings should be fitted to the 1/4" x 2" strap-iron loops so that the 2" pipe roller closes the top part of the feed slot. Clearance for free rotation of the roller must be allowed.
6. Cut semicircular pieces from the 20-gage iron and close the ends of the drum cover above the frame.

Frame

Materials Required:

2 - pieces 1-1/4" x 2" x 2" x 108" long for ends
2 - pieces 1-1/4" x 2" x 2" x 37" long to tie end together
8 - pieces 1/4" x 2" flat iron braces 24" long
4 - each 1/2" x 2-1/2" machine bolts

Fabrication:

1. Cut notches 27" from each end of 108" angles and bend ends to 25° from perpendicular. Weld the closed notches to add strength and rigidity.
2. Weld 1/4" x 2" strap-iron braces as shown in figure 1.
3. Lay out and drill 1/2" holes for bearings so that drum will be centered in the frame.
4. To complete the frame, join end pieces by welding 37" angles to each corner. This should give a rectangular opening at the top of the frame 50" x 37".
5. Weld 1/4" x 2" straps for bracing on front and rear of the frame, as shown for the ends (fig. 1).
6. Drop the drum in place and bolt bearings to the frame.

Skirting

Materials Required:

1 - piece 20-gage black sheet iron 75" long x 24" wide

Fabrication:

Fit the sheet iron around both ends and the front of the machine extending from the top of the frame downward 24". The back of the machine should be left open for trash and waste removal.

POWER REQUIREMENT

For general burnishing, ribboning, or cleaning, 5 hp. has been found adequate. This may be supplied by a closed, splashproof electric motor or by a gasoline engine equipped with a clutch for convenience in starting the engine. The power unit can conveniently be attached to the frame of the machine by a sub-frame made of wood or steel. The machine may be driven from a line shaft if such a source of power is available. If several machines are to be operated simultaneously, it may prove economical to operate them by a single power unit through a line shaft.

USES OF THE MACHINE

This machine is usable for burnishing or brushing dry fiber; for ribboning kenaf, ramie, or other bast fibrous stalks; or for cleaning and washing retted fiber.

Definition of Terms

The terms "hard fiber", "leaf fiber", and "structural fiber" are used interchangeably. This type of fiber is generally used for rope or cordage and requires no treatment other than mechanical decortication before it is ready to spin.

The terms "soft fiber", "stem fiber", and "bast fiber" are also used interchangeably. This type of fiber requires further treatment, either chemical, mechanical, or bacteriological or combinations of these, to remove nonfibrous material before it is ready to spin.

The term "ribboning" as used in this publication is intended to describe the removal from the bast strip of all of the leaves and substantially all of the shives or woody portion of the stalk so only the bast layer is left. This contains most of the cortical tissue, gums, and other nonfibrous material as well as the fiber.

The term "decortication" as used means the removal of all extraneous materials except a portion of the gums which adhere and cement the fibers together.

The term "degumming" refers to the chemical process of removing the gummy nonfibrous materials from either ribbons or decorticated fiber so clean fibers result free of all foreign material.

The term "retting" as commonly used refers to the removal of nonfibrous materials by bacteria from stem fibers.

Burnishing

(a) Cordage fiber:

Burnishing or brushing after decortication and drying to improve the alinement, cleanliness, and appearance of cordage fiber was at one time a common practice. The machine described in this publication was originally designed, because of this practice, to improve sansevieria fiber for use in the manufacture of marine cordage (fig.3).

Early tests revealed that the only worthwhile improvement was in the appearance of the fiber. This did not enhance its monetary value to the grower, thus the machine was not used to any great extent for burnishing cordage fiber.

(b) Crude ramie:

In an effort to establish a ramie fiber production industry in south Florida, research indicated that the raspador type decorticator used for hard fiber could be successfully used for ramie stalks with only minor modification. Fiber from this type of decortication was crimped, folded back, and matted somewhat, making its use in the stapled form impractical for spinning on the cotton system.

Burnishing as shown in figure 4 improved fiber alinement to the extent that the uniformity in length of fiber stapled after this operation was acceptable to spinners using the cotton system. The burnishing operation also removed all particles of shives and some bark and pulp left in the fiber during decortication. The gummy adhering strands of fiber were loosened and separated to some extent, thus facilitating stapling and degumming. Several machines of the type shown in figures 1 and 4 were constructed for use in commercial degumming plants, and the burnishing operation was adopted as standard procedure before stapling and degumming.

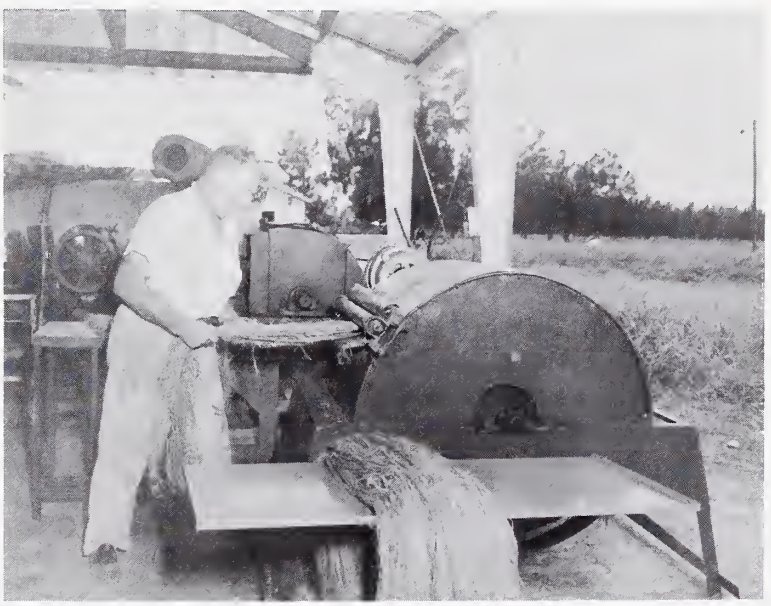

Figure 4. Burnishing ramie ribbons harvested by a field harvester-ribboner. This operation straightens and alines the fibers, removes all of the remaining wood or shives and a goodly portion of the bark or cortical tissue. The straightening and alining are essential to stapling and degumming.

The loss resulting from fiber combed out in the burnishing operation was usually less than 2 percent. Other uses were found for the tow fiber at only a slightly lower price.

Ribboning

Bast fibers of ramie, kenaf, and other woody stems

The research revealed that ramie can be ribboned instead of decorticated with less labor and machine cost, and with considerably less fiber loss.

The research with the burnisher-ribboner described in this publication resulted in the design and construction of a field harvester-ribboner that has undergone extensive tests on ramie and kenaf over a period of several years. A publication describing this machine and its performance in detail is now in preparation.

Figure 5 shows the burnisher-ribboner being used to ribbon kenaf. Ramie stems are rather soft and require little or no pretreatment before ribboning. An average operator can ribbon five or more stalks

Figure 5. Ribboning kenaf stalks on the burnisher-ribboner. The operator grasps 4 or 5 stalks by the butt ends and feeds the tips into the rotating drum. They are immediately and rapidly withdrawn and the short butt ends fed in giving clean, shive-free ribbons. Freshly made ribbons are seen at the left. The machine works equally well on ramie stalks.

at a time with little difficulty. The wood in kenaf is harder and the hollow center smaller than in ramie. The fiber is somewhat weaker and is more brittle. For these reasons kenaf works better if the stalks are squeezed or crushed first. Neoprene rollers, shown at the left in figure 5, were designed to remove excess moisture from the fiber before drying. They are also excellent for the crushing of stems before ribboning when small quantities of ribbons are wanted.

A bundle of freshly prepared ribbons can be seen on the squeeze rolls in figure 5. These are ready for water retting or for mechanical decortication.

Jute, Urena lobata, Crotalaria juncea, and other bast fiber stems have been ribboned in the machine. Jute works very well but the ribbons discolor badly even on a short exposure to the air. The other plants have hard woody cores and do not ribbon well.

Washing and Cleaning

Under most conditions bast fiber ribbons ret more uniformly and in less time than whole stalks. Cleaning and washing the fiber by hand in either case is a difficult, disagreeable, and laborious task. Cleaning involves the removal of shives, loose bark, and to some extent adhering bark when retting is poorly done. Washing involves flushing away the slime and bad odor due to bacterial action. It also aids in flushing out the materials loosened in the cleaning action. Ribbons containing even a small amount of shives are very difficult to clean by hand. Fiber that is not uniformly and well retted is also very difficult to clean by hand.

The burnisher-ribboner described in the preceding pages is well adapted to cleaning retted ribbons of jute and kenaf. Figure 6 shows a stick of retted kenaf ribbons coming from the retting tank. These are ready for washing and cleaning. Several sticks are shown already loaded on a pickup truck for transporting to the washing machine. Figure 7 shows an operator cleaning and washing the butt ends of a hank of water-retted kenaf ribbons. The other end will be cleaned by withdrawing the butts and inserting it into the drum for a few seconds. Water is supplied to the cleaning-washing operation by means of the hose attached to a fitting in the center of the cover just above the feed roll. A flood of water strikes the fiber as it is fed into the drum. For fairly well retted to well-retted ribbons, a drum speed of 250 r.p.m. should give good results. For overretted material 150 to 200 r.p.m. will give clean fiber with considerably less loss. Up to 400 r.p.m. may be needed to clean underretted ribbons.

Figure 6. Retted kenaf ribbons being removed from the tank for transport to the washing machine. All operations in preparing the ribbons as well as washing and cleaning can be done on the burnishing machine.

Figure 7. Cleaning and washing retted kenaf ribbons that have just been removed from the retting tank. Water for washing is supplied continuously by the hose attached to the front center of the cover. Clean fiber ready for drying is shown at the left.

After both ends of a hank have been cleaned, the fiber is hung convenient to the operator, as shown at the left in figure 7, until a sufficient quantity has been accumulated. To remove surplus water the fiber is put through squeeze rolls, shown at the right side of the figure, or wrung by hand before it is spread on racks to dry. Figure 8 shows freshly cleaned fiber draped over a length of pipe so that the wind and sun have access to it. In this manner, the fiber is completely dry in a few hours, ready for baling.

Figure 8. Well-retted kenaf fiber that has just been washed in the burnishing machine. When spread as shown above in the wind and sun the fiber dries in a few hours and is ready for baling.

There are a number of advantages obtained by machine cleaning retted ribbons. The more important ones are:

1. Bits of shives, phloem, and any similar material, very difficult to remove by hand cleaning, are readily removed by machine cleaning.

2. Poorly retted fiber, usually found on the butt end of the stalk, cannot be cleaned by hand. Therefore it is cut off and sold as butts at a much reduced price.

3. The quantity of fiber cleaned per man-hour is very greatly increased.

PORTABLE USE OF THE MACHINE

In response to numerous requests, plans were worked out for mounting the burnisher on a trailer, as shown in figures 9 and 10, in order to move it about the field and thus reduce the distances for transporting materials to the machine. Several of these are contemplated for commercial use.

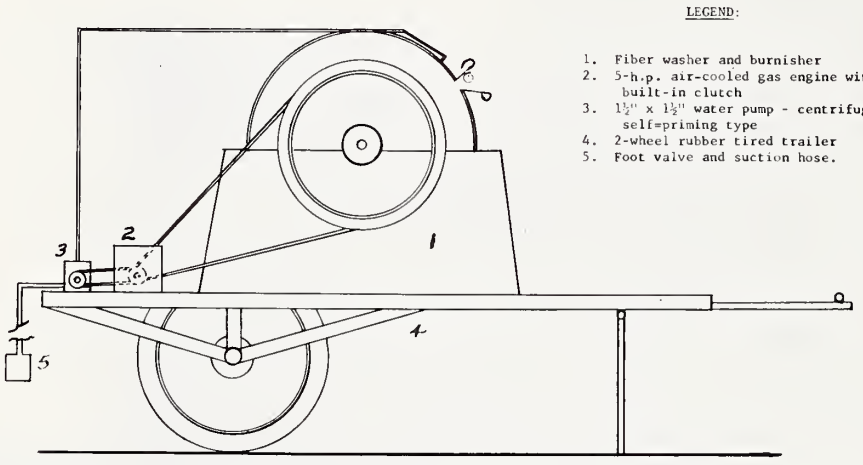

Figure 9. Elevation view of a portable washer-burnisher for retted fiber.

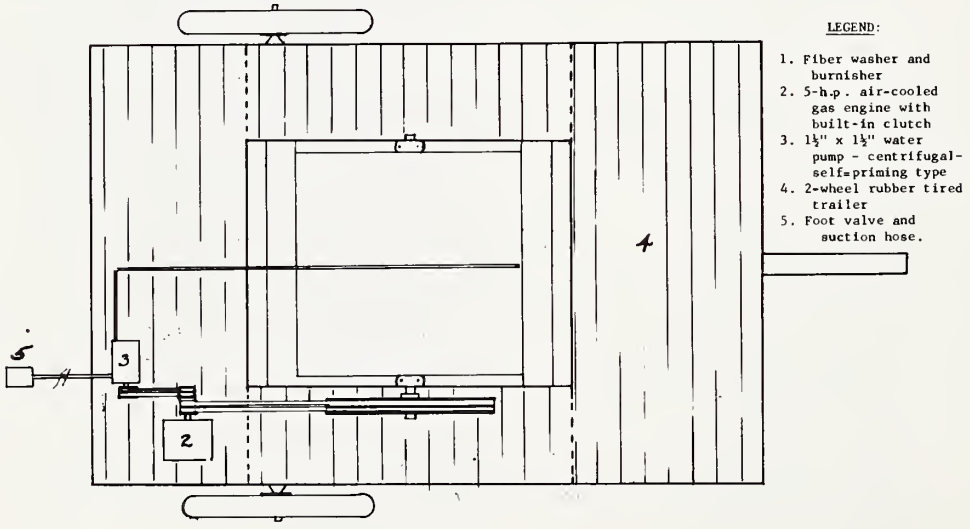

Figure 10. Plan view of a portable washer-burnisher for retted fiber.

A 5-hp. gasoline engine equipped with a clutch will provide ample power for most operations. For maximum use, a 7 1/2-hp. engine might be desirable. The 1 1/2- x 1 1/2-inch centrifugal self-priming pump should be equipped with a 3-inch suction hose 20 feet long. A foot valve should be provided to prevent leakage back when the pump stops. The discharge side of the pump can be connected directly to the burnisher as shown. One-inch galvanized pipe should be of ample size for the connection. Power should be supplied by the engine, the pump shaft turning at the same speed as the engine crankshaft. When water is not needed the belt should be removed to prevent wear or damage to the pump.

The drum of the burnisher, operating at 250 to 275 r.p.m., gives good results for most washing and cleaning operations. Average quality ramie or kenaf will also ribbon well at this drum speed. A 4- to 24-inch pulley ratio has proved satisfactory when an electric motor operating at 1,750 r.p.m. was used to supply the power. The average small gasoline engine should be operated at about 2,250 r.p.m. for maximum efficiency. This speed increase may require a 30-inch pulley on the drum shaft.

The machine and trailer combination as shown has no springs; consequently it would not be satisfactory for high-speed road transport. The floor of the trailer has been left open under the machine so that the trash and waste falls directly on the ground.

Growth Through Agricultural Progress